Introduction

Several reconnaissance level studies have been conducted within the Snake-Payette Hydrologic Unit. The following section briefly summarizes these studies.

The Idaho Snake-Payette Water Quality Hydrologic Unit Project is one of the 74 projects funded nationally by United States Department of Agriculture (USDA). The purpose of these 5-year, federally funded projects is to accelerate the transfer of technology necessary to protect ground water and surface water quality while maintaining farm profitability. The project has five phases: (1) determination of ground water problems in the study area, (2) development of nonpoint source pollution control mechanisms (best management practices, BMPs), (3) implementation of developed nonpoint source pollution control mechanisms, (4) develop an economic evaluation of BMP effectiveness in relation to social acceptability, and (5) develop an information and education plan evolving from information used and gathered from the project. (Mahler, 1991).

This assessment addresses the first phase of the Idaho Snake-Payette Water Quality Hydrologic Unit Project; it provides a determination of nonpoint source agricultural impacts on ground water quality located in the Snake-Payette Rivers Hydrologic Unit. It defines the water quality critical areas that may have been impacted by agricultural activities. In turn, these critical areas provide direction and focus to participating agencies involved in implementing nonpoint source pollution control mechanisms to prevent further impact.

Previously, the Idaho Division of Environmental Quality (**IDEQ**) had identified the area now known as Snake-Payette Rivers Hydrologic Unit in the *Non-point Source Pollution Assessment Report* (IDEQ,1988) as being one of the most water quality sensitive areas in Idaho. The pollutants were identified as **nutrients** and **pesticides**.

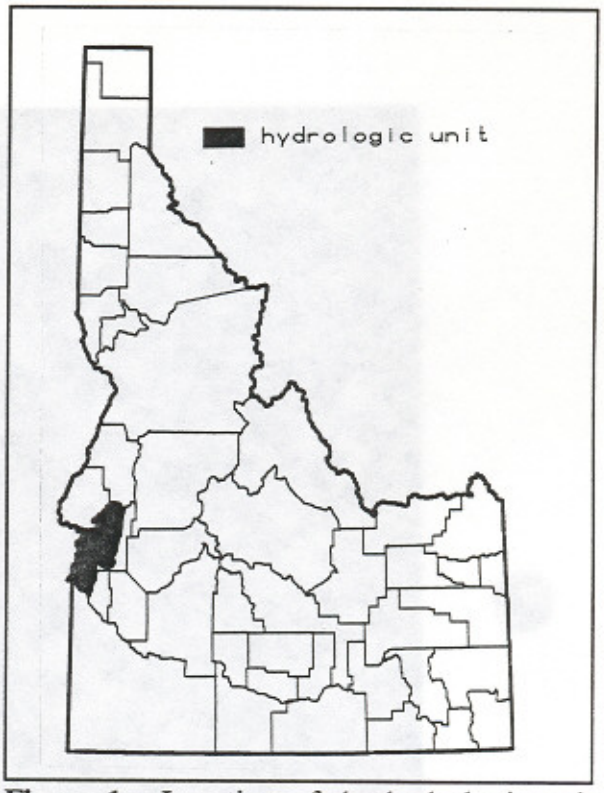

Figure 1. Location of the hydrologic unit within Idaho.

This assessment only addresses agricultural nonpoint source contamination. Agricultural point source contamination caused by inadequate well head protection, septic, or mixing pad problems are not differentiated from nonpoint sources; data are insufficient to differentiate. Identified point sources of contamination can be addressed by established enforceable pollution control mechanisms. On the other hand, agricultural nonpoint sources of contamination do not have precise pollution control mechanisms.

Agriculture in Idaho has a chance to demonstrate that voluntary nonpoint source pollution control mechanisms are successful. The success of these nonpoint source pollution control mechanisms may decrease regulatory activity by already concerned federal and state legislators.

Purpose and Objectives

The purpose of this report is to meet Idaho Division of Environmental Quality's (IDEQ) commitment to the Idaho Snake-Payette Rivers Hydrologic Unit Project (ISPRHUPP).

One objective is to identify the extent of non-point source pollution of ground water from pesticides and nutrients (ISPRHUPP (b), 1991: p. 22). Another objective is to pinpoint problem areas and to quantify nutrients and/or pesticides present in ground water, by analyzing and characterizing available well survey data (ISPRHUPP (b), 1991: p. 22).

Past Project and Literature Review

A study conducted in the Weiser River basin, by the U.S. Geologic Survey (1977) was part of a continuing cooperative program of water-resources investigations with the Idaho Department of Water Resources (**IDWR**). The study was designed to meet the needs of the IDWR in planning for water-resources development and in administering water rights and the needs of water users. Most of this study area is northwest of the hydrologic unit area with some overlap in the Weiser area. Ground water samples were collected and analyzed from 35 wells throughout the study area. Nitrite plus nitrate as nitrogen concentrations ranged from 0 to 9 mg/ℓ. The higher nitrogen concentrations within the 0 to 9 mg/ℓ range were attributed to organic wastes or excessive fertilization.

The Oregon Department of Environmental Quality (ODEQ) sampled 107 wells, during the period from 1987 through 1989, in the Ontario area for contaminants. This water sampling project was initiated because routine public water supply system sampling, by EPA, revealed concentrations of **nitrate-N** above the federal drinking water maximum contaminant level (**MCL**) of 10.00 mg/ℓ and the presence of Dacthal (or its acid metabolite). The first EPA sampling results, from 1983, indicated nitrate concentrations as high as 49.00 mg/ℓ. The Snake-Payette Rivers Hydrologic Unit area is located immediately east across the Snake River, and both areas are located in the same regional ground water basin. The Ontario area sampling revealed concentrations of nitrate-N, sodium, arsenic, selenium, and lead above the EPA MCLs. Concentrations of nitrate-N for the Ontario area exceeded the MCL in 35 of 107 wells tested, ranging from 11.00 to 39.20 mg/ℓ. It is not known if the samples were analyzed for pesticides.

An investigation of the quality of the Fruitland area ground water was conducted by IDEQ (unpublished). Sixteen ground water samples were collected and analyzed for nitrate and pesticides. Wells sampled for this investigation included municipal, industrial, and private domestic wells. Nitrate concentrations ranged from less than 0.01 mg/ℓ to 12.9 mg/ℓ. Nine of the 16 samples contained nitrate in excess of 5 mg/ℓ; two of the 16 wells exceeded the MCL (10 mg/ℓ). Dacthal (or its acid metabolite) concentrations ranged from

0.04 $\mu g/\ell$ to 10 $\mu g/\ell$ in 12 of the 16 samples.

A study of the quality of the Weiser area's ground water was conducted by IDEQ (unpublished). Seventeen ground water samples were collected from domestic and irrigation wells. The water samples were analyzed for nitrate and pesticides. Nitrate concentrations ranged from 0.6 to 22 mg/ℓ, with 14 of the 17 samples containing greater than 5.0 mg/ℓ nitrate. Eight of the 17 wells exceeded the MCL for nitrate. Dacthal or its acid metabolite concentrations ranged from 0.09 to 73.2 $\mu g/\ell$ in 12 of the 17 sampled wells.

A study of the quality of the lower Payette area's ground water was conducted by IDEQ (Baldwin and Wicherski, in prep.). The purpose of this study was to collect information for the Payette Soil and Water Conservation District on ground water and soil conditions within the study area to be used in identifying critical areas for planning and other tasks. The scope of work included area-wide ground water sampling of 80 wells to determine general water quality within the project area. A subset of 30 wells was selected for quarterly sampling over a one year period to examine seasonal variations in water quality parameters. The report concludes that "ground water impacts from nitrates have been detected over the entire study area, based on comparison to an assumed background nitrate concentration of less than 0.005 mg/ℓ. Area wide and quarterly sampling indicate that impacts are more severe on the west side of the study area." (Baldwin and Wicherski, in prep.)

Study Area

The Snake-Payette Rivers Hydrologic Unit area is located primarily in the west central part of Idaho, with the exception of a small portion that is located in eastern Oregon. The Snake-Payette Rivers Hydrologic Unit contains over 840,000 acres, within portions of five Idaho counties, Adams, Canyon, Gem, Payette, and Washington, and a portion of Malheur County, Oregon. There are 13 communities ranging in population from approximately 300 to 5,400; these communities are shown in Figure 2. The larger communities of Payette, Emmett, and neighboring Weiser average approximately 5,000 in population. Within the area there are 3,400 farms covering 60,000 acres. The four major rivers are the Snake River, the Payette River, the Boise River, and the neighboring Weiser River. The hydrologic unit is approximately 1,350 square miles in area and ranges in elevation from 2,100 to 4,026 feet above mean sea level.

Climate

The data used to describe the climate of the hydrologic unit was acquired from the Climatological Data Annual Summary, Idaho (NOAA, 1990). This reference is the basis for much of the following discussion.

The climate of the hydrologic unit is **semiarid**, and is bordered by a subhumid climate in the higher mountains to the north and to the northeast. In general, the weather of the basin is characterized by warm, dry summers and cool, wet winters. The weather for the last six years has been dryer than normal with precipitation levels

of about 77 percent of normal. Mean annual temperatures are 51.9°F at Emmett, 50.6°F at Parma and 54.1°F at Payette.

The freeze-free growing season is approximately 154 days. Mean annual precipitation near Weiser is 11.9 inches, with the highest mean monthly precipitation occurring in December and January; the lowest precipitation occurs in July and August. Average soil temperature for 1990, based on measurements taken four inches below surface, for Emmett was 66.1°F and for Parma was 59.3°F. There were very few days that the soil temperatures fell below freezing (32°F).

Soils

The soils found in the hydrologic unit are described in the *Soil Survey of Payette County, Idaho* (SCS, 1976), the *Soil Survey of Canyon Area, Idaho* (SCS, 1972), and the *Soil Survey of Adams/Washington Co.* (unpublished) . These references are the basis for much of the discussion below.

Generally the soils found in the hydrologic unit are derived from **basaltic** volcanic rocks, or sediments of **lacustrine**, **fluvial**, and **eolian** origin.

There are five general soil regions within the hydrologic unit. The first soil region, soil region 1, is the northernmost and is derived from basalt residuum. It is well drained and occurs on gently to steeply sloping uplands. A prominent characteristic of the soils of this region is a well developed clayey subsoil with high shrink-swell potential. Soils in region 1 are generally deep. Typical soils in soil region 1 include the Gem, Glasgow, Newell, and Brownlee Series.

The next region (soil region 2) is located southwest of the first and interfingers with soil regions 3 and 4 further southwest. Soils in region 2 are generally **loams** derived from alluvial sediments. Soils are well drained and are very deep. Typical soils in soil region 2 include the Haw, Payette, Power, Purdam, and Van Dusen Series.

Soil region 3 is located further to the southwest and is proximal to two of the major rivers in the hydrologic unit area: the Payette River and the Snake River. The soils in this region are derived from lacustrine sediments and mixed **alluvium** and are typically silt loams and silty clay loams. Drainage class ranges from poorly to well drained. Typical soils in soil region 3 include the Moulton, Baldock, Chilcoot, and Greenleaf Series.

Soil region 4 is located on either side of soil region 3, along the upper terraces of the Payette River. This soil region is derived from alluvium and **loess**. The soils in the region are distinguished from the other soil regions by the dominance of fragmented **duripans**. Soil profiles are shallow to moderately deep and these soils are of the well drained classification in the areas without the duripan horizon. Typical soils in soil region 4 include the Elijah, Lanktree, Vickery, Chilcoot, and Letha Series.

Soil region 5 is located in the southern part of the hydrologic unit. Soils are derived from well mixed sediments, and are very deep. Textures are generally more sandy than the other soil regions and the drainage class ranges from somewhat poorly drained to well drained. Typical soils in soil region 4 include the Harpt, Turbyfill, Cashmere, Cencove and Feltham Series.

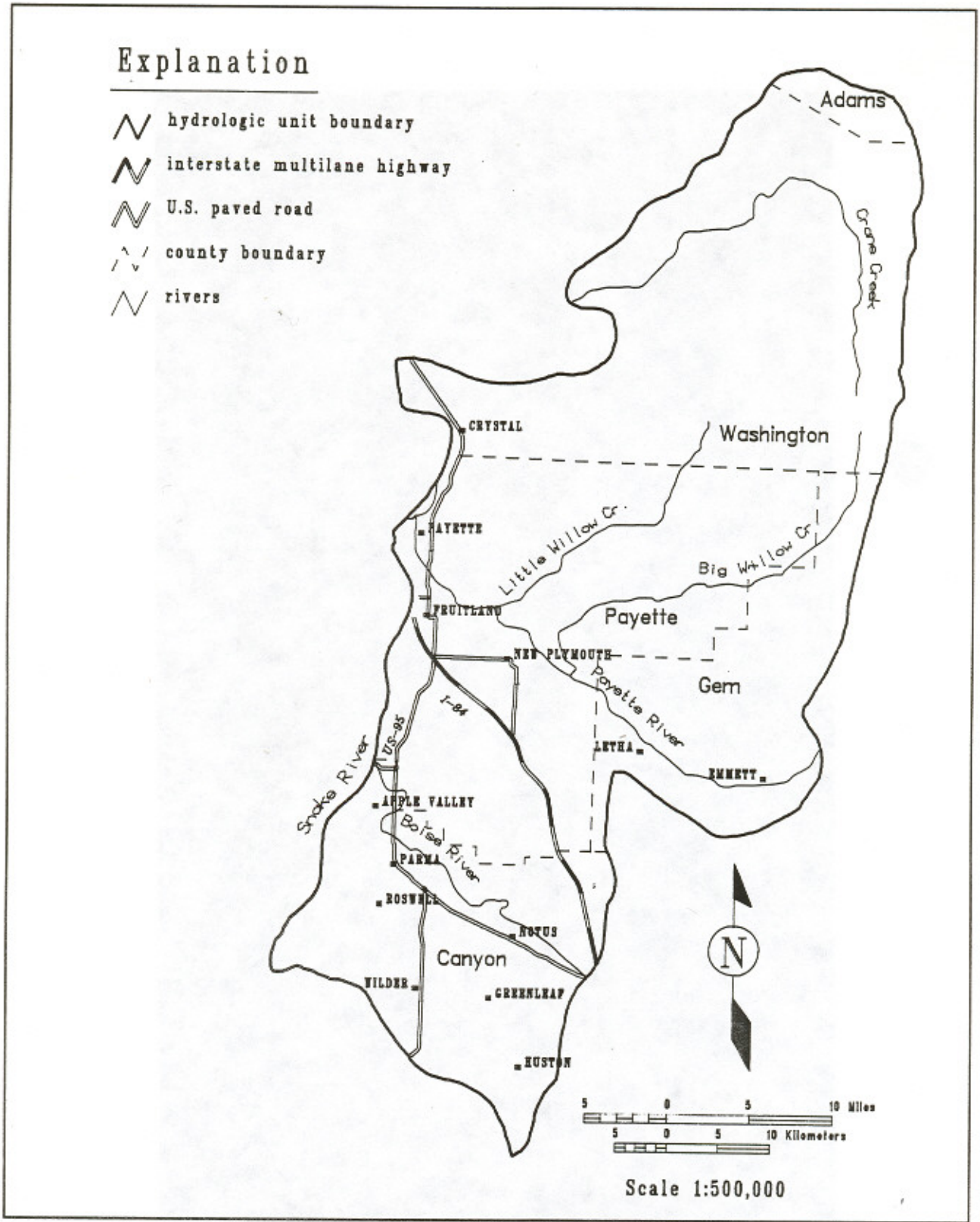

Figure 2. Major communities in the hydrologic unit.

Figure 3 shows the five general soil regions of the hydrologic unit area. This map was refined from the State Soils Geographic Database (STATSGO) GIS coverage that was developed by USDA Soil Conservation Service. Note that no data are represented for the Oregon section of the hydrologic unit.

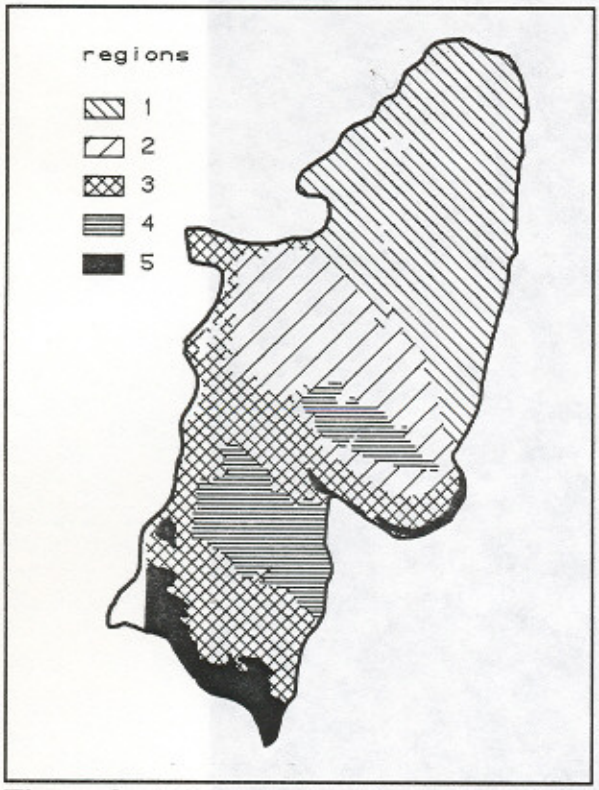

Figure 3. The general soil regions of the hydrologic unit.

Geology

Figure 4 shows the general geology of the hydrologic unit. It is refined from the *1:500,000 Geologic Map of Idaho* (Idaho Geological Survey, 1978). The units are as follows: Qa, Quaternary alluvium; Qpa, **Pleistocene** water laid detritus; Qpg, Pleistocene outwash; Tmd, Miocene stream and lake deposits; Tpd, Pliocene stream and lake deposits (Glenns Ferry Formation); Tmb, Miocene plateau basalt flows.

There are two different geologic regimes within the hydrologic unit. The first, which is extensively used for agricultural land, is dominated by lacustrine and fluvial deposits. The second which is sparsely populated and left as open range, is dominated by volcanic deposits.

The lacustrine deposits, southwestern portion of the hydrologic unit are geologically located within the Western Snake River Plain, an elongate feature that stretches from King Hill on the east to the Idaho-Oregon border on the west. The Western Snake River Plain is a fault-bounded depression, with **normal**, northwest-trending fault systems forming major segments of both edges of the plain (Malde, 1965). The depression of this area is believed to be aided by the weight of dense **Miocene** basalts. Above the Miocene basalts are sediments from **Pliocene** stream and lake deposits of the Glenns Ferry Formation, and younger alluvium and outwash. The Glenns Ferry Formation is the oldest and the deepest unit in the lacustrine regime, and is a thick unit, with a variable thickness of at least 5,000 feet. This formation is composed of clays, silts, and sands with some inter-bedded gravels. The top of this unit had been eroded prior to the deposition of the overlying sediments. Above the unconformity are **Quaternary** alluvium and outwash from the erosion of the adjacent uplands. This overlying unit is the result of deposition by the ancestral Snake, Boise, and Payette Rivers during glacial run off. This unit filled valleys that were formed in the underlying Glenns Ferry Formation. Overlying the alluvium and outwash is a soil mantle. The mantle is composed of sand and silt and is

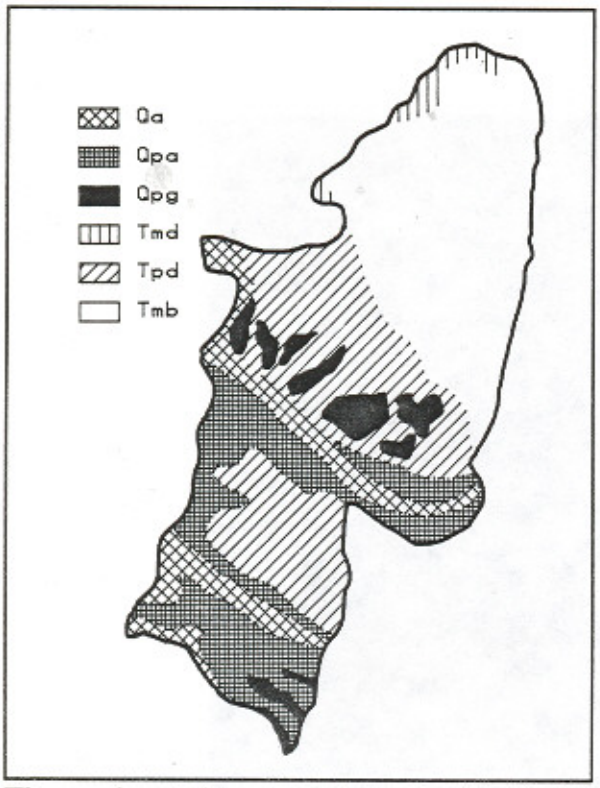

Figure 4. The general geology of the hydrologic unit (geologic unit description in text).

variable in thickness. This mantle is further described in the previous soils section.

The volcanic, northeastern regime of the hydrologic unit, located on the foot wall of the Western Snake River Plain, has lithologic differences from the southwestern regime. The northeastern regime is located within Miocene basalt flows and Miocene stream and lake deposits associated with volcanic episodes.

The landforms of the hydrologic unit are rounded with low topographic relief. The hydrologic unit is located within the Columbia Intermontane Plateau Province.

Hydrology

The principle aquifers in the basin are in the Miocene basaltic rocks, the overlying Tertiary sediments (Glenns Ferry Formation), and Quaternary sediments. Ground water occurs under artesian and water table conditions in these aquifers. Shallow water table conditions exist throughout the hydrologic unit.

The Miocene basaltic rock aquifers are located in the northeastern portion of the hydrologic unit. These basaltic rock aquifers are less productive, and receive a small portion of the water use from the water users of the hydrologic unit.

The sedimentary rock aquifers are located in the lacustrine, southwestern portion of the hydrologic unit. Within the sedimentary rock aquifers exist two water producing units. The gravel aquifer that underlies the soil mantle is as a major source of ground water for much of the hydrologic unit area. In some areas, the unit is as much as 200 feet thick and is generally saturated throughout most of the thickness. The second water producing unit is the Glenns Ferry Formation. Well yields from the Glenns Ferry Formation are variable and generally have lower yields than the overlying unit.

Figure 5 shows the major aquifer types and their approximate location within the hydrologic unit. This map does not represent the smaller aquifers in the upland valleys. This GIS coverage was produced by IDWR.

Land Use

Just as the hydrologic unit is split into two different geologic regimes, the hydrologic unit has two different types of

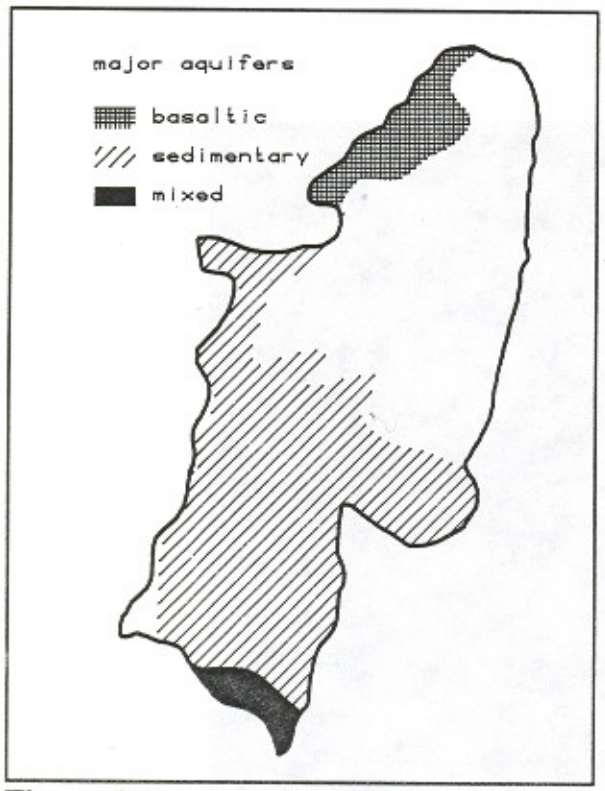

Figure 5. The major aquifer types of the hydrologic unit.

land use. The southwestern portion is primarily irrigated agricultural, and the northeastern portion is primarily open range.

Agricultural and related activities are the main economic support for the southwestern portion of the hydrologic unit. This agricultural area is one of the most productive agricultural areas in Idaho. More than 40 different crops are grown, including onions, potatoes, sugar beets, corn, mint, orchard fruit, vegetable seed, and seed crops. See Table I for the distribution of the acreage between these crops. Most of the crops are either gravity or sprinkler irrigated, however, there are a few dryland farms.

The northeastern portion of the hydrologic unit is primarily used for raising stock and recreation. Many of the operations that are raising stock also farm small amounts of alfalfa and/or other grasses for stock yard feeding. Most farming in this rangeland is associated with wet meadows adjacent to streams.

Table I. Major agricultural crops within the hydrologic unit (acreage determined by Mahler, 1991)

Crop	Acres
alfalfa	76,800
barley	25,100
beans	12,100
corn	20,800
hops	2,600
oats	9,800
onions	7,700
orchards	12,090
peppermint	11,000
potatoes	5,000
seed crops	8,800
spearmint	2,000
sugarbeets	39,100
wheat	52,400

Figure 6 shows the general land use within the hydrologic unit. The GIS coverage was developed in three portions. The first portion was mapped by the Idaho Department of Water Resources. It was produced by delineating irrigated and dry farmland areas from 1:250,000 "Landsat False Color Composite" images taken in 1986. The second portion consisted of "Irrigation Water Management" data developed by **USDA** Soil Conservation Service. This portion represents irrigated farmland as either sprinkler or gravity-fed water delivery systems. These data were last field checked in 1983. The third portion was the "Actual Vegetation Map of

Idaho" created by Steve Caicco, and Ciscell (IDWR, in press). This portion was mapped at a scale of 1:500,000. The specific vegetation types were aggregated into five general categories representing rangelands, agriculture, forests, lava flows, and riparian areas.

Water Use

All communities within the Snake-Payette Rivers Hydrologic Unit pump domestic water from wells, which is one of the greatest justifications for protecting ground water. The non-domestic water use in the northeast, open range portion of the hydrologic unit is significantly less than the non-domestic water use in the southeast, agricultural portion.

About 85 percent of the cropland in the, southeast agricultural portion of the hydrologic unit is furrow irrigated. The remaining cropland is either sprinkler irrigated (15 percent) or is dry farmed.

Water for irrigation is delivered through several canals, that which the result of irrigation projects and were constructed in the early 1900's. These canals now deliver water to more than 200,000 acres of farmland. Reservoirs on the Boise, Payette, and Weiser Rivers and their tributaries are the primary storage sources for this water. Irrigation water is also pumped or diverted from the Snake River.

Materials and Methods

This assessment was prepared using existing data from various sources, explained in this section. This section also explains the computer data management techniques that were used to compile this data into a useable data base.

Sources of data

The data used in this hydrologic unit ground water assessment were generated from three sources. These sources are the Idaho Farm Bureau Federation reconnaissance ground water quality surveys (**IFBF/RGWQS**), IDEQ special projects, and the **USGS/WRD** data base. There are a total of 436 samples considered. The data are represented in tabular form in the Appendix of this assessment, (Table IV, V, and VI).

Idaho Farm Bureau Reconnaissance Ground Water Quality Surveys

The IFBF/RGWQS consisted of individual county-wide sampling events, conducted to generate reconnaissance level nitrate ground water data. The methods used for each of these surveys were similar. Private domestic wells were used within the general area. Portions of two of these surveys (Canyon County IFBF/RGWQS, January 1991, and Gem and Payette Counties IFBF/RGWQS, March 1991) were used to describe conditions in the hydrologic unit. These IFBF/RGWQS were performed through a cooperative interagency and private sector program. Participants include; the Idaho Farm Bureau Federation (**IFBF**), local County Farm Bureau Federations, the Idaho Division of Environmental Quality, the University of Idaho Analytical Laboratory, and members of the general public.